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Title: STABILIZATION OF URANIUM METAL BY CHLORIDE CONVERSION-ECONOMICAL, SAFE, SCALABLE

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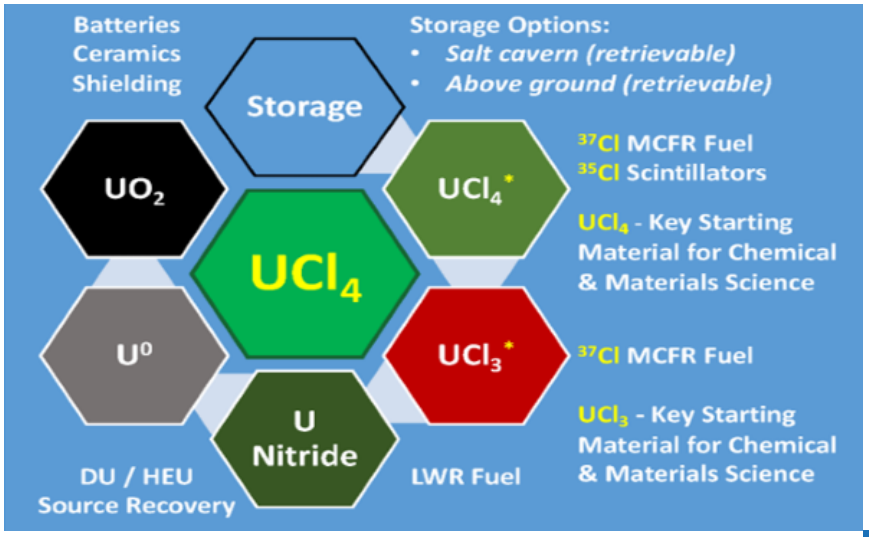

Los Alamos NATIONAL LABORATORY EST.1943

Tech Snapshot

Chemistry

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STABILIZATION OF URANIUM METAL BY CHLORIDE CONVERSION-ECONOMICAL, SAFE, SCALABLE

(SUCCESS)

BENEFITS

This solution-based chemistry provides:

- Conversion of pyrophoric uranium metal to stable chloride, suitable for storage.
- One step conversion and purification of low-purity metal.
- Recyclable solvents and reagents.

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SUMMARY

Researchers at Los Alamos National Laboratory have developed SUCCESS, a process to convert uranium metal to uranium tetrachloride enabling production of these valuable compounds for actinide science, molten salt nuclear reactors, and energy research. Conventional methods are problematic due to the oxide reduction processes use rare reagents and generate significant amounts of waste and hydride conversion process using chlorine at high temperature is hazardous. This new method using inexpensive reagents chemically transform uranium metal into uranium halide compounds under mild conditions. The facile conversion to stable uranium tetrachloride could reduce the need to mine uranium for uses other than nuclear, by recycling the uranium without oxidation. The Laboratory is interested in supporting further scale-up efforts using a Cooperative Research and Development Agreement (CRADA) or by granting a license to a qualified entity

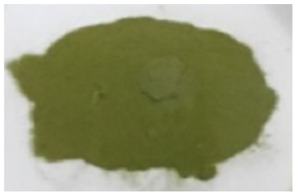
MARKET APPLICATION

Nuclear and actinide science are niche markets that have a wide breadth of stakeholders including university, government and commercial researchers. Given the interest in clean energy and the revitalization of commercial investment in developing Generation IV nuclear reactors within the United States, these materials will play a pivotal role in rapidly expanding actinide research as well as better recycling approaches for uranium metal as mining of uranium ores becomes more restricted.

URANIUM METAL TURNINGS

$U^0_{(Metal)} \rightarrow UCl_4$

URANIUM TETRACHLORIDE POWDER



WHY WE ARE BUILDING STABILIZATION OF URANIUM METAL BY CHLORIDE CONVERSION-ECONOMICAL, SAFE, SCALABLE

Uranium is a strategic national defense asset with different assays and enrichments including depleted uranium (DU), low-enriched uranium (LEU), high-assay LEU, and HEU. DOE/NNSA is currently exhausting usable inventories of high-purity DU metal feedstock used for weapons production. DOE/NNSA projects a shortfall of depleted uranium between FY2029 and FY2031. The NNSA Materials Recycling and Recovery (MR&R) program is interested to investigate alternate processes and technology improvements that can increase the efficiency of traditional manufacturing processes, such as DU machining.

WHAT'S BEHIND OUR TECHNOLOGY

Inexpensive United States sourced reagents chemically transform uranium metal into uranium halide compounds under mild conditions. Minimal processing is required in order to achieve clean material at scale which is an improvement over prior methods. The uranium halide can subsequently be converted to metal, oxide, nitride, or other halides. Solvent is recoverable by vacuum distillation.

OUR COMPETITIVE ADVANTAGES

Mild reaction conditions and simple processing steps affords kilogram-scale of material preparation. This process lowers the barriers to commonly used materials that requires import from China. Lower cost production of uranium tetrachloride opens the path to long-term storage and can be much more readily converted back to metal as compared to oxide conversion.

OUR TECHNOLOGY STATUS

Los Alamos researchers have demonstrated selective dissolution of uranium leaving common impurities such as carbon, silicon, and iron behind as solids. They are demonstrating additional scale-up chemistry and have developed a method for recycling the solvent used in the process. The Laboratory is interested in supporting further scale-up efforts by way of a CRADA or by granting a license to a qualified entity.

PUBLICATIONS AND IP

S133643.001, *"Metal Complexes and Methods of Making the Same";* U.S Patent Appl. No. 16/509042, Appl. Date 07/11/2019.